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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/644,643	08/20/2003	Jian Wang	02-40181-US	5489

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EXAMINER

BOUTSIKARIS, LEONIDAS

ART UNIT PAPER NUMBER

2872

DATE MAILED: 06/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/644,643

Applicant(s)

WANG ET AL.

Examiner

Leo Boutsikaris

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 01 June 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-39 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-39 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 August 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6/1/06 has been entered.

### ***Drawings***

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: "22" and "22'" in Fig. 1, "220" and "222" in Figs. 9A and 9B. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and

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informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-39 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Newly amended claims 1, 22, 33 and 39, all include the limitation that each of the at least two nanostructures includes a metallic and a dielectric material located adjacent each other so that the dielectric only partially extends along the long surface of the metallic. This is in addition to the (old) limitation that there are at least two groove layers, each groove layer interstitial to a respective nanostructure. The examiner is unable to ascertain the above combination.

First, it is noted that the claims present at the most recent amendment, filed on 3/17/06, were clearly corresponding to the embodiment of Fig. 2, where two nanostructures 24a and 24b are positioned on each side of buffer layers 32, 34, with a groove layer 20 positioned interstitial to each nanostructure ([0028] in the specification). Second, it appears that the new limitation of the metallic/dielectric combination corresponds to Fig. 1. Regarding Fig. 1, the specification discloses two nanostructures 20 and 24 ([0025]). One of the nanostructures, e.g., 20, comprises a combination of a high refractive index material, e.g., a metallic with refractive index  $n_f$  and a low refractive index material, e.g., a dielectric with refractive index  $n_o$  ([0026]). Based on the above,

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it is not possible to have at least two groove layers, wherein each of the at least two groove layers is interstitial to a respective one of the two nanostructures. For examination purposes, the new limitation regarding the dielectric/metallic combination will not be considered. It is suggested that said claims are amended so that they accurately reflect the embodiment depicted in Fig. 1.

It is also noted that claims 1, 22, 33 include the old limitation that the wavelength is in the range of about 250 nm to less than about a microwave wavelength, which was amended in the last amendment of 3/17/06 (due to 112 issues). It will be assumed that Applicant intended to include the language of the 3/17/06 amendment, regarding the wavelength range, in all the independent claims.

Claims 2-21, 23-32, 34-38 inherit the deficiency of claims 1, 22, 33 from which they depend.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-2, 5-9, 11-22, 25-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverstein (US 6,844,971) in view of Perkins (US 6,288,840).

Regarding claims 1, 21-22, Silverstein discloses a grid polarizer (Fig. 5) for polarizing incident light and therefore maximizing the transmission of one polarized component (e.g., p, see

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Fig. 6a) (while minimizing the reflection of said component) and at the same time maximizing the reflection of the orthogonal polarized component, i.e., s (while minimizing the transmission of said component), see also lines 14-18, col. 16. The grid polarizer comprises a substrate 405, two nanostructures 430, one each on each side of the substrate, and each having feature sizes on the nm order, and two groove layers 440 and 442, each one interstitial to a respective nanostructure (lines 19-38, col. 11). Furthermore, in one embodiment, Silverstein discloses that a dielectric layer 580 may be formed between the substrate 505 and the groove layer 540 (lines 53-63, col. 16, Fig. 8d). Finally, Silverstein teaches that an AR coating may be also included in the structure to broaden the wavelength spectrum and improve the efficiency and transmitted contrast (i.e., the extinction ratio) of the polarizer device (lines 45-57, col. 11). It is noted that the above device is used with visible light, which lies within the claimed wavelength range.

However, Silverstein only shows a single dielectric layer 580 between the substrate 505 and the groove layer 540, instead of the claimed plurality of such dielectric layers. Perkins discloses a grid polarizer (Figs. 6-7), wherein he teaches that a plurality of dielectric layers 31 or 35 may be formed between the substrate 3 or 1 and the groove layer formed between nanostructure elements 5 (lines 1-16, col. 8). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a plurality of dielectric layers between the substrate and the groove layers in the polarizer of Silverstein, as taught by Perkins, since the use of more than one dielectrics is advantageous to the operation of the polarizer (see lines 12-14, col. 8 in Perkins). It is also noted that the dielectrics used in Perkins have refractive indices greater than 1 (line 6, col. 8).

Regarding claim 2, the groove layers comprise grooves (lines 23-25, col. 11).

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Regarding claim 5, the nanostructures are metallic (line 28, col. 11).

Regarding claim 6, in one embodiment, the nanostructures 530 comprise a plurality of dielectrics e.g., 570, 572, 574 (lines 42-49, col. 16, Fig. 8c).

Regarding claims 7-9, 25-26, the groove layers comprise a dielectric having a lower conductivity than the respective nanostructure, since the groove comprises air and the nanostructure is metallic, said two elements having different refractive indices.

Regarding claim 11, each of the nanostructures comprises a plurality of wires (line 23, col. 11).

Regarding claims 12, 27, the two nanostructures are parallel to each other (lines 29-33, col. 11).

Regarding claims 14, 29, the two nanostructures are separated from each other by spacer layer 405 (Fig. 5).

Regarding claims 15, 30, each nanostructure may be 100 nm or 200 nm thick (lines 1-10, col. 14).

Regarding claim 18, the extinction ratio/contrast is substantially high (see Figs. 7e, 7f) by using a device which is less than 0.2 mm (lines 40-42, col. 17).

Regarding claim 20, each nanostructure comprises a rectangle (see Fig. 5).

Regarding claims 16-17, 19, 31-36, 38-39, Silverstein in view of Perkins discloses all the limitations of said claims except for specifically teaching that the width of each element in the nanostructures is about 30 nm, or that the transmissivity is greater than about 97%, or that the extinction ratio is greater than about 40 dB, or that the incidence angle is up to about 20 degrees. Instead, Silverstein does teach that the grid width may be about 65 nm (grid pitch being 144 nm

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and duty cycle being 45%), see lines 48-49, col. 13; the transmissivity may be greater than 80% and the extinction ratio 36 dB (4,000:1), see lines 7-10, col. 16; and the incidence angle may be in a range depicted in Figs. 7a-7d. It would have been obvious to one of ordinary skill in the art at the time the invention was made to design the polarizer stack of Silverstein so that it exhibits the claimed values for the various optical properties, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Optimization of said variables would result in an optical polarizer that exhibits a desired performance, e.g., high extinction ratio while at the same time transmitting most of the incident light.

Regarding claims 13, 28, 37, Silverstein in view of Perkins discloses all the limitations of said claims except for teaching that an etch stop layer is included in the polarizer stack. It would have been obvious to one of ordinary skill in the art at the time the invention was made to include an etch stop layer during the fabrication of the polarizer stack of Silverstein, since Official Notice is taken that the use of etch stop layers during photolithographic micro-patterning is widely known in the micro-optics field, because such protective layers allow for more accurate micro-patterning using various etching techniques.

Claims 3-4, 10, 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverstein (US 6,844,971) in view of Perkins (US 6,288,840) and further in view of Imaizumi (US 2003/0007251).

Regarding claims 3-4, 23-24, Silverstein in view of Perkins discloses all the limitations of said claims except for teaching a pair of protective layers covering both ends of the polarizer



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device. Imaizumi discloses a polarizer device comprising a first and a second nanostructure 3a, 3b, and a first and a second groove layer 2a, 2b, each groove layer being interstitial to a respective nanostructure (Fig. 5, [0035]). A protective layer 5 is formed on top and beneath said nanostructures, groove layers and substrate 1. It would have been obvious to one of ordinary skill in the art at the time the invention was made to cover the polarizer device of Silverstein with a protective layer on each top and bottom surface for improving the light-transmissivity and polarization of the device by suppressing reflective scattering (see [0042] in Imaizimi).

Regarding claim 10, Silverstein in view of Perkins discloses all the limitations of said claim except for teaching that a dielectric material is interstitial to each nanostructure, instead of air. As described above, in Imaizumi's polarizer device dielectric material 2a, 2b is formed between the nanostructure elements 3a, 3b. It would have been obvious to one of ordinary skill in the art at the time the invention was made to fill the grooves in Silverstein's polarizer with a dielectric material other than air, as taught by Imaizimi, for better flexibility in designing the polarizing function of the polarizing stack to exhibit a designed polarization extinction ratio and overall transmission efficiency. By choosing dielectric materials having different refractive indices one skilled in the art can design a polarizer by using an additional parameter (i.e., the relative difference in the refractive indices of the materials comprising the grooves and the nanostructures) in addition to parameters such as the relative thicknesses, widths, etc.

### ***Conclusion***

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Leo Boutsikaris whose telephone number is 571-272-2308.

The examiner can normally be reached on M-F, 10-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Dunn can be reached on 571-272-2312. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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June 8, 2006

  
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